John Giessner

From: Ross Telson
Sent: Wednesday, July 16, 2008 12:21 PM
To: John Thorp
Cc: Kent Wood; Thomas Herrity; Mahesh Chawla; John Ellegood; John Giessner; Robert Lerch; Frank Tran; Mark King; David Pelton
Subject: ACE for CR-PLP-2007-03105.doc
Attachments: ACE for CR-PLP-2007-03105.doc

John,

Per our discussion this morning, I've attached the Palisades Apparent Cause Evaluation (ACE) associated with the licensee's 7/30/07 corrective action document (CR-PLP-2007-03105) addressing a history of spent fuel pool fuel rack swelling that appears to date back to 1991 (highlighting is mine). The ACE provides useful background and contributed to licensee testing discussed at today's 8:15 call following the licensee's preliminary indications (today) that the spent fuel pool fuel racks may have less neutron absorption ability than assumed in design analyses.

The residents (John Ellegood (SRI) and Jack Giessner) are following this issue and, in support of any generic review activities deemed necessary and appropriate by NRR, they will pass to Kent and Tom any significant additional insights as they develop. At this time, we have *not* identified any immediate safety concerns or questions that would warrant action beyond the licensee's administrative limits on SFP boron and ongoing "blackness" testing & data analysis.

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C 10

Condition Report Number:	Assigned Department:
CR-PLP-2007-03105	System Engineering (Reactor)

PROBLEM STATEMENT: *(The **WHAT**)* (see Procedure step 5.4[2](a))

Note: *This event was previously evaluated per CR-PLP-2007-03105 CA-00001. CARB subsequently directed that a lower tier apparent cause evaluation be performed.*

During fuel shuffle in the Spent Fuel Pool (SFP) on 07/30/2007, the Spent Fuel Handling Machine (SFHM) was unable to lift assembly S35 from NUS rack location R-12. A hoist overload occurred as soon as the assembly lift was attempted. Alignment was re-verified and the lift attempt was repeated per procedure SOP-28 with the same results - auto stop on overload.

This SFP fuel shuffle was being performed to prepare for new fuel receipt. As there were adequate space available without this move, the move of S35 from R-12 was aborted and the remaining staging moves were completed.

Does this ACE report require an Equipment Failure Evaluation (EFE)? (See procedure steps 5.4 [2](b) and 5.5) ☐ Yes ☒ No

IF Yes, THEN complete Attachment 9.7 Equipment Failure Evaluation **AND** attach in PCRS

IF No, THEN an EFE analysis is not required.

Was an HPER assigned & performed for this CR? ☐ Yes ☒ No

(See procedure step 5.4 [2](b))

IF Yes, THEN ensure results of the EN-HU-103 HPER are discussed in the Event Description.

EXPLANATION OF PROBLEM: *(the **HOW**)* (see Procedure step 5.4[2](c))

NUS Rack Description

The NUS racks, also known as the Region I racks, consists of 422 storage cells and were installed in 1977 to increase SFP storage capacity. A rack assembly consists of a rectangular array of storage cans with a minimum 10-1/4 inches center-to-center spacing of the fuel assemblies. Each cell is approximately 12 feet in length with an inside square cross sectional length of 8.56 inches. A cell consists of two concentric 1/8 inch Type 304 stainless steel cans with B_4C neutron absorber plates installed in the annular gap between the cans. The top and the bottom of the two cans were closed by welding a spacer between the two cans on either end. Originally the design called for the annulus to be water tight, but cell wall swelling due to internal gas production from gamma exposure necessitated the drilling of 3/16 inch vent holes in the upper region of each cell.

The neutron absorber plates were manufactured by Carborundum. The manufacturing process bonded B_4C powder in a carbon matrix through a sintering process producing a hard ceramic like material. The absorber is 50% B_4C by volume with the remainder being carbon and voids. The absorber was fabricated into 0.21 inch thick plates. A number of these plates were inserted in the annular space.

History of NUS Rack Stuck Fuel Assemblies

Currently there are ten identified stuck fuel assemblies in the SFP NUS rack. The following list identifies the ten assemblies currently classified as stuck.

Assembly	Cell	Date In	Discovered	Condition Report
K65	K-4	10/05/1990	01/22/1991	D-PAL-91-0015, C-PAL-95-0343
K04	I-3	09/23/1992	03/11/1994	D-PAL-94-0078
K16	N-4	09/23/1992	04/20/1995	C-PAL-95-0357
C141	F-11	09/23/1992	04/13/2001	C-PAL-01-1392
B19	H-12	09/23/1992	04/14/2001	C-PAL-01-1417
B66	Q-18	04/13/2001	01/19/2003	CAP032988
C139	U-8	07/17/1988	11/22/2003	CAP038744
Q34	I-10	04/15/2001	10/03/2004	CAP044237
Q31	I-9	04/12/2001	04/15/2006	
S35	R-12	10/03/2004	07/30/2007	CR-PLP-2007-03105

During the Cycle 7 offload in 1988 it was not possible to insert a fuel assembly in cell G-19. G-19 has not been used a storage location since this occurrence.

During Cycle 9 core reload on January 22, 1991, fuel assembly K65 could not be extracted from cell K-4 under a maximum load of approximately 2500 lbs utilizing the Spent Fuel Handling Machine (SFHM). The overhead crane was used to apply a load of 3400 lbs to the assembly without any detected. Fuel assemblies are normally extracted with little or no resistance (e.g., SFHM load cell reading ≈1400 lbs).

Also during Cycle 9 reload, there were problems extracting fuel assembly L06 located in cell Q-8. An applied maximum load of approximately 2500 lbs was required to remove fuel assembly L-006. Fuel assembly L-006 was subsequently lowered and raised in an alternate storage location with no high SFHM load cell indication. Presently, cell Q-8 is not used to store fuel. These two events were documented in D-PAL-91-015.

During UT inspections for dry fuel storage on March 11, 1994, fuel assembly K04 could not be fully extracted from cell I-3 using a maximum load of approximately 1750 lbs. The overload limit was reached with the fuel assembly approximately two feet out of the storage cell. The fuel assembly would not lower using normal procedures. The assembly was lowered back into the cell using the weight of the fuel assembly to overcome the binding forces. This event was documented in D-PAL-94-078.

Fuel assembly K16 was found to be stuck in cell N-4 on April 18, 1995, during a fuel shuffle to support the offload during the 1995 refueling outage. The overload was set at 1535 lbs. The fuel assembly did not move using the maximum force of 1535 lbs. C-PAL-95-0343 was written to document and capture all of the stuck fuel assembly events.

Investigation of these first three stuck assemblies (K65, K04, and K16) and the first two blocked cells lead to an apparent cause that the stuck fuel assemblies are a result of fuel assembly to cell wall interaction due to cell wall swelling. The swelling is a result of pressurization of the annular space because of radiation induced gas generation that lacks a vent path.

There are significant differences between the original group of stuck batch K assemblies and blocked cells identified in the early 1990's and the next four events. The three K assemblies were discovered to be stuck relatively soon after they were discharged, when they were still producing considerable heat and radiation. They had similar discharge assemblies placed in adjacent cells such that the cell walls were exposed to relatively high radiation levels and thus had high gas generation rates.

Conversely, C141, B19, B66, and C139 were all discharged from Cycle 1 and were producing relatively low radiation fields at the time they were discovered to be stuck. C141, B19, and B66 were moved into the region near the south tilt pit gate on 9/23/1992 after cooling for almost 17 years. They remained undisturbed until April 2001 when C141 and B19 were discovered to be stuck. B66 was successfully moved from K-13 to Q-18 with no problems identified. In fact, 39 of 41 Cycle 1 assemblies were successfully relocated from the area near the south tilt pit gate. Due to dose issues, this region is only accessible for moving irradiated fuel when the south tilt pit is flooded, such as during a refueling outage. Prior to September 1992, this region was typically unoccupied except during refueling outages in which the full core was off-loaded. Therefore, the cell walls in this region have been exposed to lower than average lifetime radiation fields (and gas generation rates). Cell U-8 is not within this south tilt pit gate region and has been occupied since 1983. In fact, assembly C139 has been in cell location U-8 since 7/17/1988, had not been disturbed in over 15 years prior to being discovered to be stuck.

Assemblies Q34 and Q31 were discharged in April 2001 (EOC 15) to the NUS rack near the south tilt pit gate. At that time, a large group of discharge assemblies were placed in this region. Q34 and Q31 were undisturbed for three and a half or five years respectively before they were discovered to be stuck.

It is suspected that the vent hole of cells with stuck fuel assemblies may be plugged or were mis-drilled during installation. The racks were initially fabricated without vent holes, but the need for venting was identified prior to installation in the SFP. The vent holes were drilled prior to installation but records from the vent hole drilling project are inconclusive as to the precise location of the vents. The vent holes of the cells containing stuck fuel assemblies cannot be examined since the holes are covered by the assemblies. Probing of G-19 and Q-8 vent holes revealed that these vent holes were plugged, but did not determine the reason for the plugging.

History of NUS Rack Blocked Cells

In addition to the stuck assemblies three empty cells, M-7, Q-8 and G-19, are identified as blocked. Cell M-7 was recently discovered to be blocked on 8/27/07. These cells are administratively controlled and not used for fuel storage because of past problems encountered while extracting or inserting fuel assemblies. Cells M-7 and Q-8 are now used to store items with smaller cross sections than fuel assemblies.

Camera inspections of cells Q-9 and G-19 have revealed an inward distortion of the inner cell walls. This would support the theory that the fuel assemblies are stuck due to swelling of the storage cells in which they are stored.

During March 1995, a specially designed tool was used to probe the vent holes of Q-8 and G-19. The tool consisted of a 1/4 inch stainless steel welding rod attached to a Cam-Lock attachment. A camera was used to aid in probing the vent holes. The evolution was video taped. Camera inspection of the vent holes revealed a buildup of a substance at the vent hole. The probe was used to break away the substance apparently blocking the vent hole and once the probe scraped away enough of the substance, a large volume of gas was released. The gas was released in the form of small, fine bubbles. This scenario occurred with both vent holes. The operator was able to scrape enough of the substance from the vent hole of G-19 to insert the probe into the vent hole. It was not clear how far into the vent hole the probe was able to penetrate. The operator could not remove enough material from Q-8's vent hole to enable insertion of the probe. The release of gas from each vent hole continued for approximately one hour. Also, the black, cloudy material described earlier seeping from a cell vent hole was also captured on video tape during the evolution.

Stuck Assembly S35 Discussion

Cell R-12 has been used extensively. See table below for the occupancy history of cell R-12:

Assembly	Date In	Date Out	
XF67	04/09/81	10/09/85	
H62	12/26/85	06/13/88	
K22	03/10/92	09/23/92	
G22	09/28/92	05/07/93	
L36	06/26/93	04/13/95	
N34	11/01/96	02/12/99	
S47	10/09/99	11/02/99	(New Fuel)
O18	11/02/99	02/22/01	
T15	03/02/01	04/12/01	(New Fuel)
C111	04/12/01	11/24/03	
C111	11/24/03	02/11/04	
C111	02/11/04	07/19/04	
V40	08/27/04	10/03/04	(New Fuel)
S35	10/03/04		

Note that the multiple moves for assembly C111 were for UT and visual exams prior to placing

C111 in Dry Fuel Storage.

No problems were noted on the move sheets of recent moves (O18, T15, C111, and V40) out of R-12 prior to placing S35 into R-12 in 2004. As a EOC 17 discharge assembly, S35 was producing relatively high radiation fields. S35 was a thrice-burned assembly with a Cycle 17 burnup of 16022 MWd/MTU and a total discharge burnup of 44145 MWd/MTU. Therefore, S35 was generating a relatively high radiation field, but not exceptionally high compared to other discharge assemblies. All other EOC 17 discharge assemblies have been successfully moved from their initial SFP discharge location. This includes several assemblies with higher burnup and Cycle 17 power than S35.

The high radiation fields and resulting gas generation rates are only an issue if the vent path is blocked. Many cells in the NUS racks have been exposed to higher radiation fields than the cells with stuck assemblies with no adverse effects observed. It is most likely that vent holes for cell R-12 have become plugged, for if the vents had been mis-drilled during fabrication, it is likely that an earlier assembly, L36, N34, or O18 would have become stuck when they were discharged to R-12.

Operating Experience

These events do not appear to be common to the rest of the industry that have NUS racks containing Carborundum. Queries of the industry have not revealed other stuck assemblies. One possible explanation for this is that other plants' NUS racks have larger vent holes. The vent holes at Calvert Cliffs are approximately 1/2 inch, while the vent holes at Palisades are 3/16 inch. If the precursor to a stuck assembly is plugging of the vent hole, a 3/16 vent hole would be easier to plug than a larger vent hole.

EDF (France) did indicate that they have observed the swelling phenomenon with their NUS racks and attributed it to water logging of the B_4C panels. This information contradicts NUS testing for water saturation effects. The NUS testing results predicted that exposure to water would cause minimal swelling of the panels.

Significant Event Report 13-81, "Swelling of B_4C Poison Plates in Fuel Rack", was addressed in ACE003211 for assembly C139. In the SER, off gassing of the absorber is blamed for swelling of the racks at Kewaunee. Kewaunee's racks are not vented. The Connecticut Yankee plant is mentioned as having a similar problem, solved by venting their racks.

OE6431 - Degradation of Carborundum Boron Carbide Spent Fuel Pool Rack Poison Test Sample was addressed at Palisades by C-PAL-95-0343. Connecticut Yankee removed a Carborundum test coupon in December 1993 for a ten year inspection. The examination revealed partial decomposition of the coupon resulting in a 7% reduction in plate weight. The coupon holder contained sediment that was determined to originate from the coupon. The Connecticut Yankee NUS rack was originally installed without vent holes in 1976. Vent holes were drilled into the cells in 1978. A vent hole was drilled in the top and bottom of each cell. Analysis of the coupon B10 areal density determined that the B10 loading was 2% less than the required value. Palisades does not have coupons for the NUS rack. Palisades does not have a vent hole in the bottom of the cell which creates a flow path.

Carborundum Test Report CB078-299 describes test conditions for the coupons that are more severe than actually encountered during use in the racks. For example, the test coupons were immersed in a circulating fluid during irradiation that does not represent actual use in the racks. The actual rack use is sealed encapsulation with only the small vent hole as a possible exposure point to pool water. The actual condition should substantially reduce any dissolution or washout of the B_4C material.

The evaluation of CAP032988 (B66) identified one partially related event from Vermont Yankee in 2001, which involved contact between the fuel channel fastener and their new BORAL racks. For BWR fuel, the bundle is contained in a channel and the head of a fastener that secures the channel to the bundle protrudes slightly above the surface of the channel. Given the tight tolerances of their new SFP racks, Vermont Yankee encountered a few cases of interference. As their racks are constructed with BORAL, swelling of the cell wall, as has occurred at Palisades, is not an applicable mechanism.

APPARENT/CONTRIBUTING CAUSE(S): *(the **WHY**)* (see Procedure step 5.4[2](d))

The apparent cause of S35 being stuck in NUS cell R-12 is the result of fuel assembly to cell wall interaction due to cell wall swelling. It is most likely that vent hole for cell R-12 has become plugged.

Contributing Cause

A contributing cause for the pressure buildup within the NUS racks is the vent hole size, location, and blockage vulnerability. Originally purchased without vent holes, the NUS racks were field modified at the Palisades site. Poor documentation exists as to the hole size (drawing specs called for 0.19" diameter holes), location, and verification that the holes were actually drilled in all of the cells. A mis-located hole could result in the hole being drilled into solid material, preventing venting of the sandwich material. A hole diameter of 0.19" seems to be disputed in several previous corrective action documents, with hole variability identified as a noticeable difference between cells. *Only one small hole is intended to vent all four sides of a cell,* a potential problem if cell tolerances limited exchange of gasses between cell walls, or the single hole becomes blocked.

An earlier corrective action document noted that an internal pressure of 4 to 5 psi was sufficient to cause wall swelling of the thin walled cell, sufficient to cause the wall to contact the fuel assembly.

EXTENT OF CONDITION: (see Procedure step 5.4[2](e))

With respect to the mechanical impact on the fuel assemblies due to the swelling of rack cell walls; the cell walls will primarily contact the guide bars, grid straps, upper and lower tie-plates with only minimal contact force on peripheral fuel rods. The guide bars in particular, unique to Palisades fuel, provide protection from contact.

Cooling flow through the affected SFP rack cells is expected to be minimally impacted. The SER for the NUS racks evaluated the unlikely event of foreign material blocking cooling flow in one or more fuel assemblies. This analysis showed the maximum clad temperature would be less than 250 °F, considerably less than the minimum clad failure temperature of over 1000 °F. Swelling of the rack walls would not impede cooling flow inlet located at the bottom of the cell. Contact of a fuel rod to the stainless steel wall would still provide adequate heat transfer.

The most notable unknown condition associated with SFP Region I rack swelling is with respect to the criticality analysis impact that would result from a loss or reconfiguration of B_4C material.

Palisades spent fuel pool water has been routinely tested for Total Organic Carbon (TOC), and the levels are very low (< 0.2 ppm) and stable, indicative of minimal loss of material. Note TOC sampling was not initiated for B_4C condition monitoring, rather since TOC will break down into corrosion forming constituents in the PCS, SOER 82-13 recommends TOC analysis on all systems that can come in contact with the PCS. Also, oil or grease may get into the pool from machinery used around the pool, such as the crane. TOC is monitored in the SFP to ensure high TOC water does not enter the PCS. Additionally, the testing on Kewaunee coupons supports that no significant loss of material is occurring.

An extensive evaluation was completed by Palisades in support of the Condition Report evaluated in C-PAL-95-0343. This included input from the B_4C manufacturer, the Carborundum Company. Some of the general conclusions of the report are:

- There was visible evidence of an unidentified black material leaching through the vent holes. This could represent a small loss of B_4C material. However, because the vent holes are near the tops of the cells and the amount of observed material is small, the impact of any B_4C material loss is expected to be very slight.
- The Carborundum Company reviewed the data and concluded that the black material is very likely a boron compound but notes that boron leachability over time is relatively low , although there is no test data to document leaching over a 10-15 year time span.

- There are no vent holes at the base of the racks. Thus, a slow discharge of degraded B_4C material, with its inherent loss of reactivity hold-down, is not considered a credible scenario.

In addition, the locations of the vent holes are below the upper tie plate, but slightly above the active fuel region. Therefore, if the all the interior B_4C above the vent were to leak through the holes, there would be an insignificant amount of reactivity hold-down degradation in the active fuel region.

Because Palisades does not have rack material surveillance coupons, Palisades has requested supporting information from the Kewaunee plant, which uses a similar B_4C rack design and which has an active surveillance plan. Kewaunee responded by stating that other than some possible B_4C dust leakage and some observed chipping (most likely due to the effects of handling), there was no visible degradation of the B_4C material. However, as Kewaunee does not test for brittleness, they were unable to confirm that B_4C would not degrade under long-term temperature and radiation exposure. Therefore, it reasonable and conservative to assume at least some degree of B_4C degradation over time.

As noted above, there are no vent holes at the rack base to permit egress of degraded B_4C. As the majority of the racks remain in their original configuration, we can conclude that, except for the swollen racks, the B_4C remains in place. For the swollen rack locations, it is conceivable to consider a B_4C "slumping" effect, in which the degraded neutron absorber, now in powdered form, sinks to a lower level inside the racks, as would a liquid. Realistically, the maximum amount of slumping would reduce the absorber height to no lower than approximately 80% of its original position.

However, because slumping to that degree could remove neutron absorber function in the very top of the affected rack locations, Entergy has elected to perform a criticality assessment, considering the potential for B_4C loss and crediting SFP boron concentration to compensate.

Criticality Assessment

In order to provide assurance that k-effective was remaining within the limits of design basis assumptions, Entergy has completed a criticality assessment, with SFP boron concentration credited for reactivity holddown in lieu of B_4C. Although EA-SFP-97-02, "Region I Fuel Pool Criticality Calculations," the criticality analysis of record (AOR) takes no credit for SFP boron in the Region I rack area, the assessment provides assurance that a k-effective below 0.95 will be maintained until such time as rack repairs or blackness testing may be performed.

The criticality analysis was prepared using the existing model of the Palisades Region I racks from the AOR. The MONK computer code, used previously for the criticality analysis, is no longer available. Therefore, the racks were modeled using the CASMO series of modeling codes which are compatible with the rack model used by MONK. CASMO-4 was used for the calculated criticality values, and the model was confirmed to agree well with the original CASMO-3 analysis for the normal condition. However, Entergy is **not** licensed to use CASMO for design basis calculations; therefore, the results that follow must be considered as an assessment, suitable for operability determination, rather than a formal calculation.

Assumptions associated with the criticality assessment are as follows:

- The model assumes the entire Region 1 is filled with new fuel enriched to 4.95 w/o U-235, as noted in Technical Specification 4.3.1

- The model takes no credit for B_4C reactivity holddown. In other words, it assumes complete degradation of <u>all</u> neutron absorber and its replacement in the gap by B_4C off-gas. This is an <u>extremely</u> conservative position, but is retained as it (1) provides a more straightforward model and (2) bounds the current conditions;

- Because the U-235 enrichment is a nominal one, several cases were repeated for an actual enrichment of 5.00 w/o, which is the nominal value of 4.95 w/o U-235 plus a manufacturing uncertainty of 0.05 w/o;.

- In order to establish the most conservative conditions, an additional case was run with the gap filled with water instead of gas.

The code was run for a variety of SFP boron concentrations. The most significant of these are 1720 ppm, which is the minimum SFP boron concentration required by the Palisades Technical Specification 3.7.15 and 2550 ppm, which is the 1R19 refueling boron concentration. 2550 ppm is also a procedural minimum for normal operation in Modes 1-4, required to ensure core subcriticality after a design basis seismic event. For normal operation in Modes 5 and 6, a procedural minimum SFP boron concentration of 1800 ppm is specified.

With these considerations in mind, the results of the criticality assessment are as follows Results are in units of k-inf, which is criticality in infinite array, and bounds (i.e. is always greater than) k-effective:

1. The k-inf for Region 1, crediting a 1720 ppm boron concentration in the SFP, is below 0.98. *[calculated CASMO value was 0.97914]*

2. The k-inf for Region 1, crediting an 1800 ppm boron concentration in the SFP, is below 0.98. *[calculated value was 0.97202, linearly interpolated between two calculated CASMO values]*

3. The k-inf for Region 1, crediting a 2550 ppm boron concentration in the SFP, is below 0.92. *[calculated CASMO value was 0.91044]*

4. The SFP boron concentration corresponding to a k-inf of 0.95 is approximately 2054 ppm.

5. These conclusions remain valid if the gas within the rack is replaced by unborated water.

6. Increasing enrichment from 4.95 w/o to 5.00 w/o U-235 results in a slight increase in k-inf, across a range of 0.0015 to 0.0027.

Therefore, based on the engineering review and criticality assessments described above, it is reasonable to conclude that B_4C degradation, in the Region 1 affected areas, is likely to be very slight. However, any degree of degradation, up to and including complete loss of neutron absorber, is not expected to result in an increase of k-effective above 0.95 while the SFP boron concentration remains at or above the procedural minimum of 2550 ppm. It is recommended that temporary procedure changes are established to set the minimum SFP boron concentration as 2550 ppm in all modes

ACTIONS COMPLETED

(See EN-LI-119 step 5.4[2](f))

APPARENT OR CONTRIBUTING CAUSE, OR EXTENT OF CONDITION ISSUE	ACTION COMPLETED [note any Work Orders/Requests, ER'S, other]

PROPOSED CORRECTIVE ACTIONS

(See EN-LI-119 step 5.4[2](f))

APPARENT OR CONTRIBUTING CAUSE, OR EXTENT OF CONDITION ISSUE	CORRECTIVE ACTION DESCRIPTION [note any Work Orders/Requests, ER's, other]	Assigned Department	Due Date
Extent of Condition Issue	Procedure changes to COP-27 and related procedures to maintain SFP boron at greater than 2550 ppm in all Modes rather than just Modes 1 through 4. This limit should be maintained at least until blackness testing can be performed. Review of SFP boron sample history confirms SFP boron has been the maintained greater than 2550 ppm since	System Engineering (Reactor)	12/5/07

	5/25/03, so this limit does not appear to be unreasonable from an operational perspective.		
Extent of Condition Issue	Perform blackness testing on the NUS racks as was committed to in the License Extension SER Section 3.3.2.2.10. Scheduled completion date is 03/24/2011 or sooner. Ideal time to perform this testing would be after the 2008 DFS campaign when the maximum number of open spaces is available in the SFP.	System Engineering (Reactor)	7/30/08
Apparent Cause Issue	Evaluate establishing a periodic maintenance activity to clean NUS cell vent holes, possibly involving low pressure flushing to loosen and remove vent hole blockage.	System Engineering (Reactor)	4/30/08
Apparent Cause Issue	Evaluate value-added in establishing a periodic maintenance activity to implement the vendor recommendation contained in NUS letter 8960-NUS-365, dated October 25, 1978 to perform periodic free path measurements in a representative number of storage cells This letter provided several options to perform these free path measurements, such as movement of fuel or a dummy assembly up and down within the fuel storage cell using a load cell to detect any measurable drag.	System Engineering (Reactor)	6/30/08
Apparent Cause Issue	Evaluate methods for extracting stuck assemblies.	System Engineering (Reactor)	12/15/ 2008

TREND DATA:

Cause Codes:

Human Performance Causal Factor(s) (List all)	Equipment Causal Factors (List all):	O&P Causal Factor(s) (List all):
EN-HU-103 not adopted by Palisades, thus a Human Performance Error Review not performed.		

EFE Codes (see Procedure step 5.5 [5]):

INPO PO&C codes:	Failure Mode Codes:

ACE Evaluator (print Name): G.T. Wiggins